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Validation of a Skills Training Curriculum Model Using a Quantitative Approach (With Emphasis on Technical and Vocational Training Organization Courses)

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ABSTRACT

Purpose: The objective of this study was to validate a skills training curriculum model using quantitative methods, with emphasis on programs delivered by the Technical and Vocational Training Organization.

Methods and Materials: This quantitative study employed structural equation modeling (SEM) using the partial least squares (PLS) approach. The study population comprised experts, faculty members, and specialists in curriculum studies and technical/vocational education. Sample size determination followed the PLS criterion of multiplying the highest number of items in a construct by ten, resulting in 190 participants. Data were collected through a researcher-designed questionnaire consisting of 97 items, developed based on qualitative findings. Content validity was assessed using face validity and the Content Validity Ratio (CVR) method with Lawshe's formula, involving 12 subject matter experts. Construct validity was examined through principal component analysis in PLS. Reliability was assessed using Cronbach's alpha, composite reliability, and internal consistency measures.

Findings: Inferential results indicated that all constructs demonstrated acceptable to excellent reliability (Cronbach's alpha range: 0.737–0.975) and convergent validity (AVE > 0.50). Discriminant validity was confirmed via the Fornell–Larcker criterion. The skills training curriculum construct significantly predicted all its component dimensions (β range: 0.593–0.847; all t-values > 9.71). The highest effect was on learning activities (β = 0.847, t = 26.09), followed by objectives (β = 0.796) and grouping (β = 0.789). R^2 values indicated strong explanatory power, with learning activities having the highest variance explained (71.7%). Predictive relevance (Q^2) values were all positive, with the strongest for learning activities (0.396). The Goodness of Fit (GOF) index was 0.569, indicating an excellent model fit.

Conclusion: The validated curriculum model demonstrates high reliability, validity, and predictive power, confirming its applicability as a framework for designing and implementing effective skills training programs within technical and vocational education.

Keywords: *Skills training curriculum; vocational education; curriculum validation; structural equation modeling; PLS; Technical and Vocational Training Organization.*

1. Introduction

The development and validation of skill-based curricula have emerged as critical priorities for educational systems seeking to align learning outcomes with the dynamic demands of contemporary labor markets. In the context of technical and vocational education and training (TVET), curricular design must not only meet national development goals but also respond to global trends in technology, employment, and lifelong learning. The expansion of skills training programs, particularly those offered by national organizations such as the Technical and Vocational Training Organization, represents a strategic avenue for enhancing employability, fostering entrepreneurship, and addressing skill shortages in diverse sectors (Sadri et al., 2017; Salehi Omran & Ein Khah, 2023). As labor markets continue to evolve, there is an increasing emphasis on ensuring that vocational curricula are grounded in rigorous theoretical foundations, informed by stakeholder needs, and adaptable to both local and international contexts (Dorandish et al., 2019; Fathi Vajargah, 2022).

Recent scholarship emphasizes that the process of curriculum planning in skill-based education requires a systematic, evidence-based approach that integrates both theoretical frameworks and empirical findings (Klein, 2017). This includes needs assessment, identification of core competencies, alignment with industry standards, and iterative evaluation to maintain relevance in rapidly changing socio-economic environments (Baştemur & Uçar, 2022; Dizon, 2022). Within TVET systems, such processes have been linked to improved learner outcomes, reduced skill mismatches, and enhanced pathways to employment (Jafari et al., 2023). The role of curriculum planning becomes particularly significant in countries where skill shortages and structural unemployment coexist, creating a need for training programs that are both contextually grounded and forward-looking (Alashwal, 2020; Olumuyiwa et al., 2023).

Globally, the relevance of skills training has been amplified by the rapid transformation of work environments under the influence of technological innovation, automation, and the digital economy (Zervas & Stiakakis, 2024; Zhang & Wu, 2025). Digital skills are now considered a fundamental component of employability, with vocational curricula expected to incorporate competencies in digital literacy, online collaboration, and technology-enabled problem-solving (Ndibalema, 2025). Research on the integration of digital tools into vocational education indicates that structured curriculum design can significantly improve training effectiveness, particularly when digital competencies are embedded alongside technical and occupational skills (Zervas & Stiakakis, 2024; Zhang & Wu, 2025). Moreover, these developments have heightened the need for teacher training and professional development, ensuring that instructors possess the pedagogical and technological capabilities necessary to deliver high-quality, digitally enriched instruction (Musendekwa, 2025; Şenol & Karaca, 2025).

From a theoretical standpoint, curriculum development in skills training draws upon a range of educational planning models that emphasize adaptability, responsiveness, and the integration of multiple learning modalities (Cahapay, 2020; Fathi Vajargah, 2022). The literature highlights the importance of aligning curriculum objectives with the competencies required in targeted occupational fields, a process that often involves close collaboration between educators, industry representatives, and policymakers (Dorandish et al., 2019; Salehi Omran & Ein Khah, 2023). In addition, the CIPP (Context, Input, Process, Product) evaluation model has been widely applied to assess the effectiveness and relevance of skill-based curricula, allowing for systematic examination of both design and implementation phases (Dizon, 2022). This model is particularly useful in identifying gaps between intended learning outcomes and actual performance, thereby informing ongoing curriculum refinement.

In the Iranian context, technical and vocational training programs have been recognized as pivotal for fostering self-employment and small enterprise development, especially in rural areas where access to formal employment opportunities may be limited (Jafari et al., 2023). Studies indicate that well-designed skill training curricula can significantly enhance participants' ability to initiate and sustain income-generating activities, thereby contributing to broader socio-economic development (Salehi Omran & Ein Khah, 2023). However, the effectiveness of such programs is contingent upon their capacity to reflect real-world skill requirements, integrate practical learning experiences, and maintain alignment with national educational policy frameworks (Harfati Sobhani, 2017; Sadri et al., 2017).

Another dimension influencing skill-based curriculum design is the growing emphasis on lifelong learning and adaptability in the face of economic and technological

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change (Ndibalema, 2025; Olumuyiwa et al., 2023). Employers increasingly value workers who can update their skills continuously, respond to emerging challenges, and transition between different roles and sectors. Consequently, vocational curricula must be designed to cultivate not only technical proficiency but also transferable skills such as critical thinking, problem-solving, teamwork, and digital fluency (Zervas & Stiakakis, 2024; Zhang & Wu, 2025). This necessitates pedagogical approaches that balance structured training with opportunities for experiential learning, reflective practice, and collaborative projects (Baştemur & Uçar, 2022; Şenol & Karaca, 2025).

Despite the recognized importance of these elements, research reveals persistent gaps in the responsiveness of vocational curricula to evolving labor market needs (Cahapay, 2020; Dorandish et al., 2019). These gaps may arise from outdated content, insufficient integration of digital skills, limited industry engagement in curriculum design, or inadequate mechanisms for ongoing evaluation and revision. Addressing these challenges requires a robust curriculum validation process that examines both the structural components and the practical applicability of the training program (Fathi Vajargah, 2022; Klein, 2017). In particular, quantitative validation methods—such as structural equation modeling—offer valuable tools for assessing the relationships between curriculum components and intended learning outcomes, thereby strengthening the evidence base for curricular decisions (Dizon, 2022).

The role of teacher competence in delivering skill-based curricula cannot be overstated. Instructors serve as mediators between curriculum design and learner experience, translating theoretical plans into practical, engaging, and effective learning activities (Baştemur & Uçar, 2022; Musendekwa, 2025). Teacher training must therefore encompass both subject-matter expertise and mastery of contemporary pedagogical techniques, including the use of digital platforms and blended learning environments (Alashwal, 2020; Zhang & Wu, 2025). Evidence suggests that when teachers are adequately prepared and supported, skill training programs are more likely to achieve their intended outcomes, particularly in enhancing employability and promoting lifelong learning (Şenol & Karaca, 2025; Zervas & Stiakakis, 2024).

Furthermore, curriculum planning in vocational education must consider contextual factors such as cultural norms, economic conditions, and policy environments (Olumuyiwa et al., 2023; Salehi Omran & Ein Khah, 2023). Localized adaptation ensures that training programs remain relevant to the needs of specific communities while maintaining alignment with broader national and international standards (Dorandish et al., 2019; Harfati Sobhani, 2017). This dual focus on local relevance and global compatibility is essential for preparing learners to participate effectively in both domestic and international labor markets (Ndibalema, 2025; Zervas & Stiakakis, 2024).

In recent years, the integration of digital literacy and online learning components into vocational curricula has gained increasing attention, particularly in light of the COVID-19 pandemic's acceleration of remote and hybrid learning models (Alashwal, 2020; Ndibalema, 2025). Research demonstrates that blended approaches—combining online and face-to-face instruction—can enhance flexibility, accessibility, and learner engagement, provided that digital tools are effectively integrated and aligned with curricular objectives (Zervas & Stiakakis, 2024; Zhang & Wu, 2025). These approaches also demand careful attention to infrastructure, technical support, and digital inclusion to ensure equitable access for all learners (Musendekwa, 2025; Olumuyiwa et al., 2023).

Against this backdrop, the present study focuses on validating a skills training curriculum model through quantitative methods, with a specific emphasis on training programs offered by the Technical and Vocational Training Organization. The research addresses the need for systematic evaluation of curriculum components to ensure that they align with both educational best practices and the evolving demands of the labor market. By employing structural equation modeling, the study seeks to assess the construct validity, reliability, and predictive power of the proposed curriculum model, thereby providing empirical evidence to support curriculum refinement and policy decision-making (Dizon, 2022; Fathi Vajargah, 2022).

The significance of this research lies in its potential to inform curriculum development processes that are not only theoretically sound but also practically effective in preparing learners for contemporary work environments. By integrating insights from both national and international literature on vocational education, digital skills, and curriculum planning, the study contributes to ongoing efforts to enhance the quality, relevance, and impact of skills training programs (Salehi Omran & Ein Khah, 2023; Zervas & Stiakakis, 2024; Zhang & Wu, 2025). Ultimately, the validation of the skills training curriculum model aims to ensure that training initiatives under the Technical and Vocational Training Organization can effectively support learners in acquiring the competencies necessary for sustainable employment, entrepreneurial activity, and active participation in the knowledge-based economy.

2. Methods and Materials

This research adopted a quantitative approach based on structural equation modeling to validate a conceptual curriculum model for skills training. The study population consisted of experts, faculty members, and specialists in the fields of curriculum studies and educational sciences whose expertise aligned closely with the objectives of the research. These participants were selected because they possessed sufficient academic and professional experience relevant to both curriculum design and technical and vocational education. In determining the sample size, the partial least squares (PLS) method was applied, whereby the factor containing the highest number of items is identified, and the number of items is multiplied by ten. In this study, the teacher's role factor contained the highest number of items—nineteen—and therefore the required sample size was calculated as 190 participants. These individuals were engaged to assess the validity and reliability of the proposed curriculum model derived from prior qualitative thematic analysis.

The main instrument for data collection was a researcher-designed questionnaire developed specifically for this study. The questionnaire included 97 items covering all dimensions of the proposed skills training curriculum model. The items were developed based on indicators obtained from the qualitative phase of the research. The instrument was distributed among experts and specialists in curriculum design and technical and vocational training for evaluation. To ensure the validity of the questionnaire, both face validity and content validity assessments were conducted. Face validity was established through the review and feedback of subject matter experts, faculty members, and practitioners in curriculum studies, who evaluated the clarity, comprehensiveness, and relevance of the items. For content validity, the Content Validity Ratio (CVR) method proposed by Lawshe (1986) was used. In this process, experts assessed each item in terms of its necessity, relevance, clarity, and simplicity, using a three-point Likert scale. Twelve experts participated in the CVR evaluation, and according to Lawshe's table, the minimum acceptable CVR value for this number of experts was 0.56. Items with CVR values below this threshold were removed from the questionnaire. The results showed that all remaining items achieved CVR values above the threshold, confirming acceptable content validity. Construct validity was further examined through structural equation modeling using principal component analysis within the PLS framework. Reliability was assessed using internal consistency measures. Cronbach's alpha coefficient for the entire instrument was calculated at 0.974, exceeding the generally accepted threshold of 0.70 for acceptability and 0.80 for desirability. Additionally, the composite reliability coefficient was found to be 0.975, further confirming the strong reliability of the instrument.

Data analysis was performed using the structural equation modeling approach with the partial least squares (PLS) method. The analysis aimed to confirm the validity of the conceptual curriculum model developed from the qualitative phase and to test the relationships among the identified constructs. The PLS method was chosen for its suitability in handling complex models with multiple constructs and its robustness with smaller sample sizes. Principal component analysis was employed within the PLS framework to assess the factor structure and construct validity of the model. Reliability was examined through measures of internal consistency, including Cronbach's alpha and composite reliability, ensuring that the items within each construct were consistent and stable. All statistical analyses were conducted to verify that the model met the necessary psychometric standards for application in the context of technical and vocational training curriculum development.

3. Findings and Results

The qualitative data analysis from 15 semi-structured interviews with curriculum planning experts was conducted using MAXQDA 2022 software and based on the thematic analysis approach. In this phase, the data were coded line-by-line, categorized into similar semantic categories, and the final themes associated with each component of the project-based curriculum model were extracted. This analysis not only led to the identification of key elements for each component but also provided the groundwork for validating and refining the model's structure. The combined results of expert suggestions in the first round of the fuzzy Delphi process for each of the ten core components are presented in the table below.

Table 1

Descriptive Statistics of the Study Variables

Dimension	Mean	Median	Mode	Standard Deviation	Minimum	Maximum
Logic	4.18	4.50	4.73	0.719	2.36	5.00
Teacher's Role	3.90	4.21	2.16	1.065	1.89	5.00
Objectives	3.90	3.75	5.00	1.096	2.00	5.00
Learning Activities	3.86	4.39	5.00	1.220	1.21	5.00
Content	4.10	4.37	3.13	0.828	1.88	5.00
Evaluation	3.96	4.08	5.00	0.952	2.25	5.00
Location	3.83	4.25	5.00	1.158	1.50	5.00
Facilities	4.05	4.42	5.00	0.941	2.43	5.00
Time	3.97	4.00	4.00	0.866	2.29	5.00
Grouping	3.84	4.00	5.00	1.120	1.67	5.00

The descriptive statistics presented in Table 1 show that across the ten examined curriculum dimensions, the highest mean score was related to the logic dimension (M = 4.18, SD = 0.719), indicating that participants evaluated the logical structure of the curriculum model relatively favorably. The content dimension followed closely (M = 4.10, SD = 0.828), suggesting strong agreement on the appropriateness and relevance of the learning materials. Facilities (M = 4.05, SD = 0.941) and evaluation (M = 3.96, SD = 0.952) also received high average scores, reflecting generally positive assessments. In contrast, the teacher's role dimension recorded one of the lower mean values (M = 3.90, SD = 1.065), along with objectives (M = 3.90, SD = 1.096) and location (M = 3.83, SD = 1.158), indicating more variability in respondents' perceptions of these aspects. Learning activities (M = 3.86, SD = 1.220) and grouping (M = 3.84, SD = 1.120) demonstrated higher standard deviations, suggesting a wider range of opinions among participants. Overall, the results reflect a generally positive evaluation of the proposed skills training curriculum model, with all dimensions achieving mean scores above the midpoint of the scale, but also highlight areas where perceptions were more dispersed.

Table 2

Factor Loadings of the Questionnaire Items

Construct	Item Code	Factor Loading
Logic	LO1	0.603
	LO2	0.618
	LO3	0.504
	LO4	0.580
	LO5	0.652
	LO6	0.710
	LO7	0.818
	LO8	0.822
	LO9	0.742
	LO10	0.847
	LO11	0.673
Teacher's Role	RT1	0.625
	RT2	0.552
	RT3	0.732
	RT4	0.657
	RT5	0.750
	RT6	0.736
	RT7	0.679
	RT8	0.682
	RT9	0.670
	RT10	0.618
	RT11	0.787
	RT12	0.741
	RT13	0.840
	RT14	0.874
	RT15	0.838
	RT16	0.806

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	RT17	0.859
	RT18	0.593
	RT19	0.542
Objectives	OB1	0.697
	OB2	0.721
	OB3	0.804
	OB4	0.778
	OB5	0.793
	OB6	0.832
	OB7	0.739
	OB8	0.753
	OB9	0.833
	OB10	0.778
	OB11	0.735
	OB12	0.823
	OB13	0.754
Learning Activities	CA1	0.794
	CA2	0.721
	CA3	0.805
	CA4	0.782
	CA5	0.806
	CA6	0.826
	CA7	0.796
	CA8	0.747
	CA9	0.757
	CA10	0.859
	CA11	0.851
	CA12	0.822
	CA13	0.843
	CA14	0.608
Content	CO1	0.548
	CO2	0.627
	CO3	0.697
	CO4	0.577
	CO5	0.781
	CO6	0.821
	CO7	0.766
	CO8	0.731
Evaluation	EV1	0.744
	EV2	0.765
	EV3	0.809
	EV4	0.801
	EV5	0.828
	EV6	0.851
	EV7	0.812
	EV8	0.561
	EV9	0.656
	EV10	0.515
	EV11	0.684
	EV12	0.564
Location	L1	0.737
	L2	0.750
	L3	0.802
	L4	0.826
	L5	0.829
	L6	0.783
Facilities	FT1	0.644
	FT2	0.606
	FT3	0.634
	FT4	0.769
	FT5	0.837

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	FT6	0.781
	FT7	0.684
Time	T1	0.772
	T2	0.790
	T3	0.820
	T4	0.796
	T5	0.721
	T6	0.825
	T7	0.865
Grouping	GR1	0.939
	GR2	0.934
	GR3	0.523

The factor loading results presented in Table 2 show that the majority of questionnaire items met acceptable thresholds for construct validity, with loadings generally above the recommended minimum of 0.50. The highest factor loadings were observed in the grouping construct, with GR1 (0.939) and GR2 (0.934) demonstrating very strong associations with their underlying factor. Similarly, several items in the teacher's role construct, such as RT14 (0.874) and RT17 (0.859), and in learning activities, such as CA10 (0.859) and CA11 (0.851), also exhibited high loadings, indicating their strong contribution to their respective constructs. While most items demonstrated robust loadings, a few—such as LO3 (0.504), RT19 (0.542), CO1 (0.548), and EV10 (0.515)—were near the lower acceptable limit, suggesting relatively weaker associations with their factors compared to others. Nevertheless, the overall pattern supports the adequacy of the measurement model, with all constructs being represented by multiple items with satisfactory loading values, thereby confirming the structural soundness of the instrument for assessing the proposed skills training curriculum model.

Table 3

Cronbach's Alpha, Rho_A, and Composite Reliability Values

No.	Construct	Cronbach's Alpha	Rho_A	Composite Reliability
1	Evaluation	0.906	0.916	0.922
2	Facilities	0.836	0.835	0.877
3	Objectives	0.944	0.947	0.951
4	Skills Training Curriculum	0.975	0.978	0.977
5	Time	0.906	0.911	0.925
6	Learning Activities	0.946	0.952	0.954
7	Content	0.825	0.838	0.869
8	Logic	0.866	0.900	0.890
9	Location	0.878	0.881	0.908
10	Teacher's Role	0.947	0.953	0.953
11	Grouping	0.737	0.845	0.855

The reliability indices in Table 3 indicate that all constructs of the questionnaire exhibit acceptable to excellent levels of internal consistency and composite reliability. Cronbach's alpha values ranged from 0.737 (Grouping) to 0.975 (Skills Training Curriculum), with most constructs surpassing the recommended minimum threshold of 0.70 and several exceeding 0.90, reflecting outstanding reliability. Similarly, the Rho_A coefficients showed strong consistency across constructs, with values between 0.835 and 0.978, further supporting measurement stability. Composite reliability values ranged from 0.855 to 0.977, confirming that the items within each construct consistently represent their underlying latent variables. Notably, the core constructs of the model—Objectives (CR = 0.951), Teacher's Role (CR = 0.953), and Learning Activities (CR = 0.954)—demonstrated particularly high reliability, underscoring their robust measurement properties. Even the lowest-scoring construct, Grouping, still met acceptable standards (CR = 0.855), indicating that all dimensions of the skills training curriculum model were measured with sufficient precision to support valid interpretations in subsequent structural analyses.

Table 4

Convergent Validity (AVE) Values for the Study Constructs

No.	Construct	Convergent Validity (AVE)
1	Evaluation	0.505
2	Facilities	0.507
3	Objectives	0.598
4	Skills Training Curriculum	0.617
5	Time	0.639
6	Learning Activities	0.604
7	Content	0.763
8	Logic	0.536
9	Location	0.622
10	Teacher's Role	0.521
11	Grouping	0.676

The convergent validity results presented in Table 4 demonstrate that all constructs achieved Average Variance Extracted (AVE) values above the commonly accepted threshold of 0.50, indicating that each latent variable explains more than half of the variance of its respective indicators. The highest AVE value was observed for the Content construct (0.763), reflecting particularly strong convergence among its items. Other constructs such as Grouping (0.676), Time (0.639), and Skills Training Curriculum (0.617) also showed high levels of convergent validity. Constructs like Evaluation (0.505) and Facilities (0.507) were near the lower acceptable limit but still met the minimum criterion, suggesting adequate item convergence. Overall, these findings confirm that the measurement model possesses satisfactory convergent validity, with items within each construct effectively capturing the intended latent concept, thereby supporting the robustness of the proposed skills training curriculum model for further structural analysis.

Table 5

Discriminant Validity Using the Fornell–Larcker Criterion

Construct	Evaluation	Facilities	Objectives	Skills Training Curriculum	Time	Learning Activities	Content	Logic	Location	Teacher's Role	Grouping
Evaluation	0.811										
Facilities	0.539	0.812									
Objectives	0.397	0.413	0.773								
Skills Training Curriculum	0.731	0.735	0.696	0.852							
Time	0.537	0.598	0.403	0.693	0.800						
Learning Activities	0.447	0.575	0.643	0.647	0.496	0.777					
Content	0.733	0.630	0.391	0.669	0.572	0.492	0.681				
Logic	0.417	0.351	0.380	0.593	0.302	0.299	0.295	0.761			
Location	0.575	0.568	0.444	0.709	0.636	0.520	0.484	0.313	0.789		
Teacher's Role	0.461	0.484	0.583	0.779	0.333	0.584	0.267	0.678	0.411	0.722	
Grouping	0.561	0.632	0.539	0.789	0.763	0.593	0.522	0.383	0.676	0.536	0.822

The Fornell–Larcker criterion results in Table 5 show that the square root of the Average Variance Extracted (AVE) for each construct, indicated on the diagonal in bold, is higher than the correlations between that construct and any other construct in the model. This confirms that discriminant validity is achieved, meaning that each construct is empirically distinct from the others. The Skills Training Curriculum construct had the highest diagonal value (0.852), followed closely by Grouping (0.822) and Evaluation (0.811), reflecting strong separation from other dimensions. Although some inter-construct correlations were moderately high—for example, between Skills Training Curriculum and

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Grouping (0.789) and between Skills Training Curriculum and Teacher's Role (0.779)—in all cases the diagonal value exceeded the corresponding correlation coefficients. This indicates that the measurement model not only captures each latent construct accurately but also maintains conceptual distinctiveness among them, thereby supporting the validity of the proposed model for further structural analysis.

Table 6

Path Significance Coefficients (t-values)

No.	Path	t-value
1	Skills Training Curriculum → Teacher's Role	14.97
2	Skills Training Curriculum → Logic	9.71
3	Skills Training Curriculum → Learning Activities	26.09
4	Skills Training Curriculum → Evaluation	13.97
5	Skills Training Curriculum → Facilities	18.68
6	Skills Training Curriculum → Grouping	19.63
7	Skills Training Curriculum → Objectives	16.76
8	Skills Training Curriculum → Content	9.72
9	Skills Training Curriculum → Location	12.64
10	Skills Training Curriculum → Time	14.63

The path coefficient significance results in Table 6 reveal that all relationships between the Skills Training Curriculum construct and its associated dimensions are statistically significant at the conventional confidence levels, as all t-values exceed the critical value of 1.96. The strongest relationship was observed between Skills Training Curriculum and Learning Activities (t = 26.09), indicating that this dimension is most strongly explained by the overarching curriculum construct. Substantial relationships were also noted with Grouping (t = 19.63), Facilities (t = 18.68), and Objectives (t = 16.76), reflecting their central role within the model. While the lowest t-values were observed for the paths to Logic (t = 9.71) and Content (t = 9.72), these are still well above the significance threshold, confirming their meaningful contribution. Overall, these findings support the structural integrity of the model, showing that the Skills Training Curriculum construct significantly and positively predicts all its constituent dimensions.

Table 7

Standardized Path Coefficients (β values)

No.	Path	β
1	Skills Training Curriculum → Teacher's Role	0.779
2	Skills Training Curriculum → Logic	0.593
3	Skills Training Curriculum → Learning Activities	0.847
4	Skills Training Curriculum → Evaluation	0.731
5	Skills Training Curriculum → Facilities	0.735
6	Skills Training Curriculum → Grouping	0.789
7	Skills Training Curriculum → Objectives	0.796
8	Skills Training Curriculum → Content	0.669
9	Skills Training Curriculum → Location	0.709
10	Skills Training Curriculum → Time	0.693

The standardized path coefficients in Table 7 show that all relationships between the Skills Training Curriculum construct and its dimensions are positive and strong, with β values ranging from 0.593 to 0.847. The most substantial association was observed between the curriculum construct and Learning Activities (β = 0.847), underscoring the critical role of practical and interactive learning processes in the model. This was closely followed by Objectives (β = 0.796), Grouping (β = 0.789), and Teacher's Role (β = 0.779), all of which indicate significant structural importance. Moderate to strong effects were also found for Facilities (β = 0.735), Evaluation (β = 0.731), and Location (β = 0.709). The lowest coefficients were for Logic (β = 0.593) and Content (β = 0.669), suggesting these elements, while still important, have relatively less direct influence compared to other dimensions. Overall, these β values confirm that the Skills Training Curriculum model exerts meaningful and consistent effects across all its components, providing strong empirical support for its structural validity.

Table 8

R^2 Values for the Study Dimensions

No.	Dimension	R^2 Value
1	Evaluation	0.534
2	Facilities	0.541
3	Objectives	0.634
4	Time	0.481
5	Learning Activities	0.717
6	Content	0.448
7	Logic	0.352
8	Location	0.502
9	Teacher's Role	0.607
10	Grouping	0.622

The coefficient of determination (R^2) values presented in Table 8 indicate that the Skills Training Curriculum construct explains a substantial proportion of variance in its associated dimensions. The highest explanatory power was observed for Learning Activities ($R^2 = 0.717$), suggesting that over 71% of the variance in this dimension can be attributed to the overarching curriculum model. Objectives ($R^2 = 0.634$), Grouping ($R^2 = 0.622$), and Teacher's Role ($R^2 = 0.607$) also demonstrated high levels of explained variance, reflecting their strong integration within the model. Moderate explanatory power was evident for Evaluation ($R^2 = 0.534$), Facilities ($R^2 = 0.541$), and Location ($R^2 = 0.502$). Lower yet acceptable R^2 values were found for Time ($R^2 = 0.481$), Content ($R^2 = 0.448$), and Logic ($R^2 = 0.352$), indicating these constructs are influenced by additional factors not fully captured within the current model. Overall, the results confirm that the proposed curriculum model demonstrates strong explanatory capability, particularly for dimensions directly tied to teaching and learning processes.

Table 9

Q^2 Values for the Study Dimensions

No.	Dimension	Q^2 Value
1	Evaluation	0.244
2	Facilities	0.239
3	Objectives	0.341
4	Time	0.278
5	Learning Activities	0.396
6	Content	0.188
7	Logic	0.232
8	Location	0.283
9	Teacher's Role	0.286
10	Grouping	0.395

The predictive relevance (Q^2) results in Table 9 demonstrate that all dimensions of the model achieved positive Q^2 values, confirming that the proposed skills training curriculum model has predictive capability for each construct. The highest predictive relevance was observed for Learning Activities ($Q^2 = 0.396$) and Grouping ($Q^2 = 0.395$), suggesting that the model effectively anticipates variance in these key instructional components. Objectives ($Q^2 = 0.341$) also exhibited strong predictive relevance, followed by Teacher's Role ($Q^2 = 0.286$) and Location ($Q^2 = 0.283$). Moderate predictive strength was evident for Time ($Q^2 = 0.278$), Evaluation ($Q^2 = 0.244$), Facilities ($Q^2 = 0.239$), and Logic ($Q^2 = 0.232$). The lowest Q^2 value, though still positive and acceptable, was recorded for Content ($Q^2 = 0.188$), indicating comparatively weaker but present predictive power. Overall, these results reinforce the

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model's utility in forecasting performance across its various dimensions, with particularly strong predictive accuracy for constructs tied to active learning engagement and collaborative structures.

According to the Goodness of Fit (GOF) formula, the calculated GOF value for this study was 0.569. Based on the benchmark values of 0.01, 0.25, and 0.36—representing weak, moderate, and strong fit indices, respectively (Wetzels et al., 2009)—the obtained value of 0.569 indicates a very strong model fit. Therefore, the results confirm that the conceptual model of the study demonstrates an excellent level of overall goodness of fit, providing robust support for the adequacy of the proposed skills training curriculum framework.

Figure 1

Model with T-Values

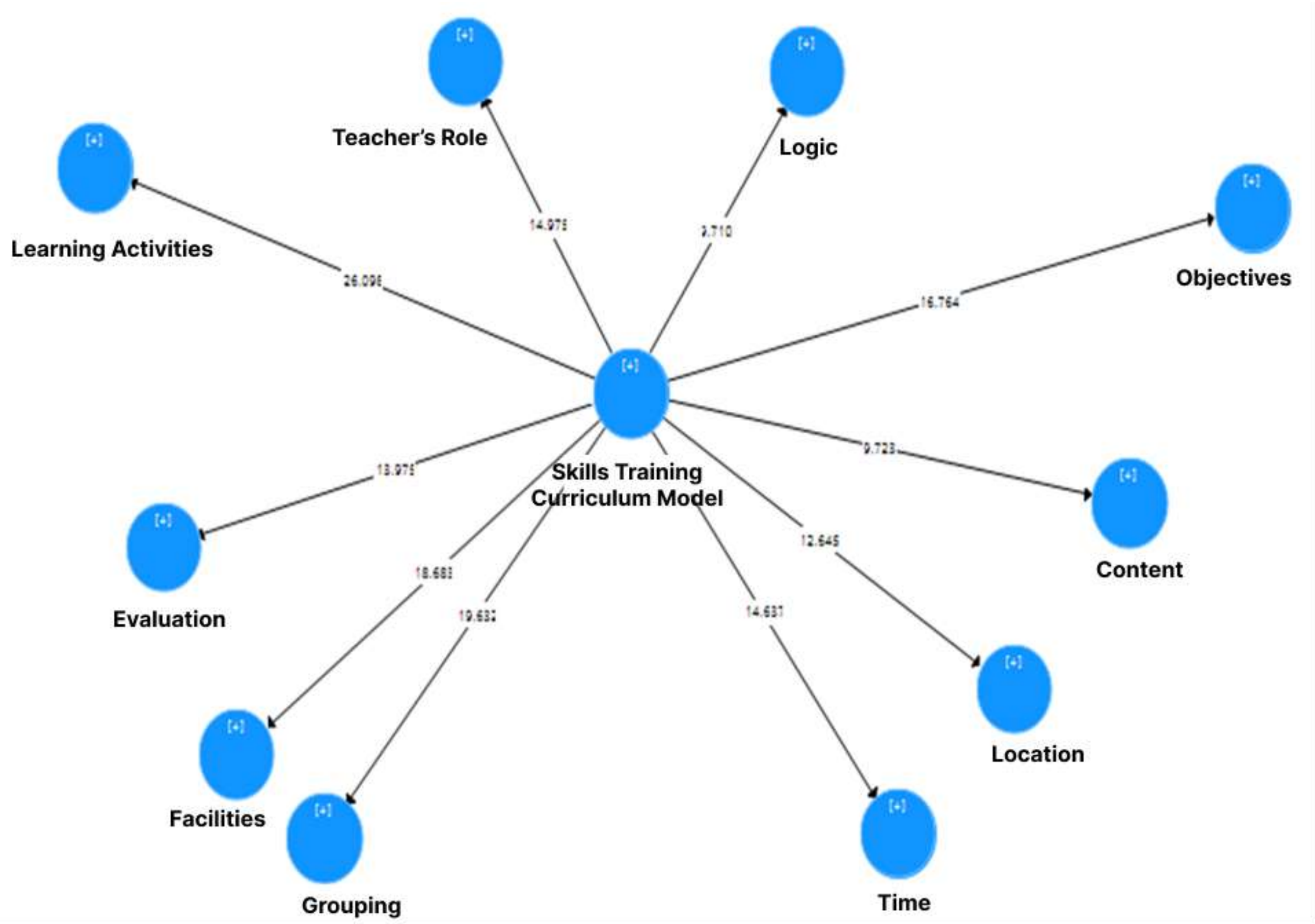
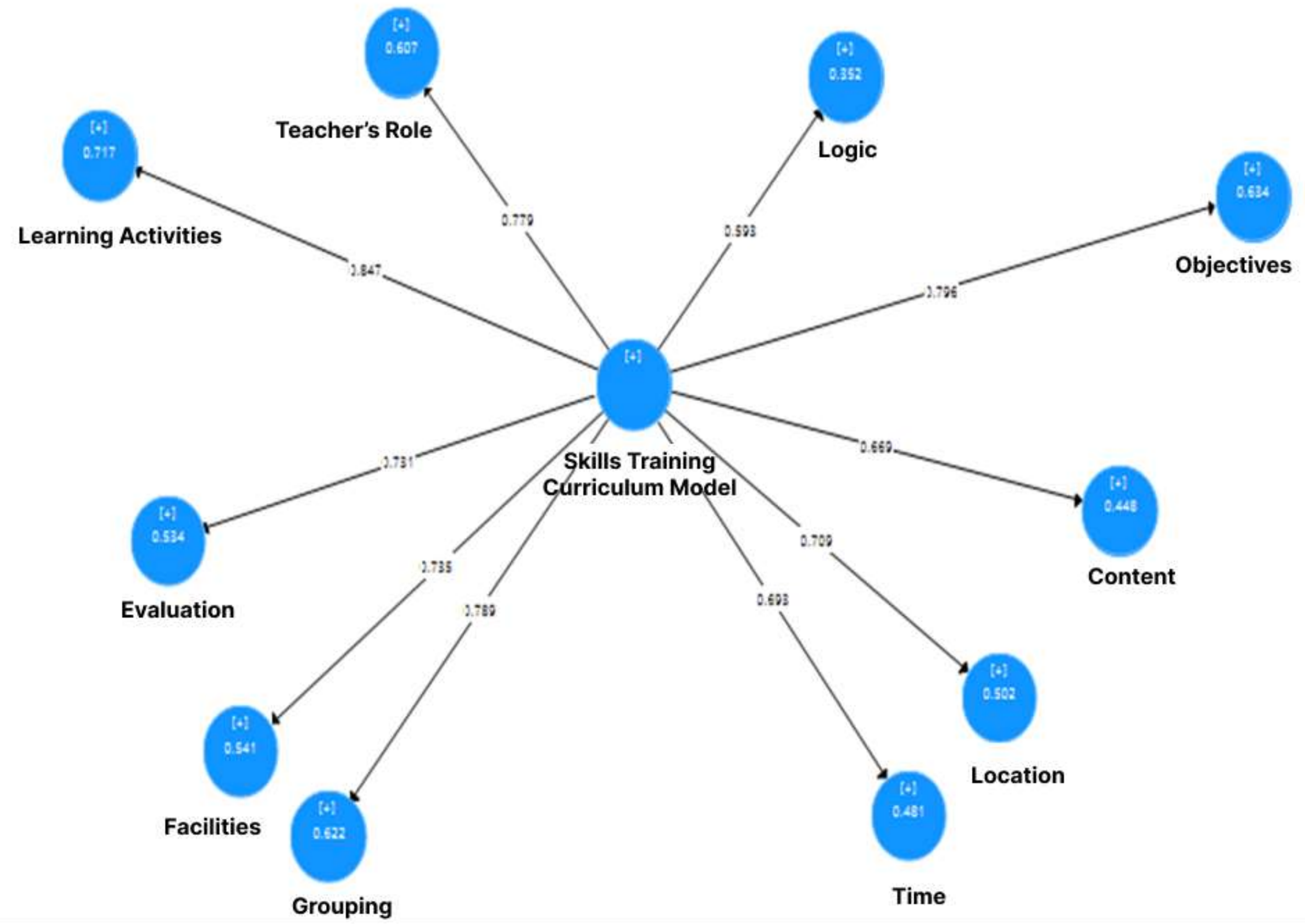


Figure 2

Model with Beta-Values



4. Discussion and Conclusion

The primary aim of this study was to validate a skills training curriculum model using quantitative methods, focusing on the dimensions relevant to programs delivered by the Technical and Vocational Training Organization. The results of the measurement model assessment confirmed that all constructs demonstrated acceptable to excellent reliability, with Cronbach's alpha and composite reliability values exceeding the recommended thresholds. Convergent validity, as indicated by AVE values, was also established for all constructs, demonstrating that each dimension captured a substantial proportion of variance in its items. Furthermore, discriminant validity, assessed through the Fornell–Larcker criterion, confirmed the distinctiveness of the constructs, despite some moderate correlations between closely related dimensions such as grouping and learning activities, or teacher's role and skills training curriculum.

From the structural model perspective, the findings revealed that the overarching skills training curriculum construct significantly predicted all its component dimensions, with path coefficients ranging from 0.593 to 0.847 and all t-values well above the significance threshold. The strongest relationship emerged between the curriculum construct and learning activities, suggesting that practical, hands-on engagement remains the most critical element in defining the quality and relevance of vocational curricula. High coefficients were also observed for objectives, grouping, and teacher's role, reflecting the centrality of clear learning goals, collaborative learning structures, and effective instructional leadership in curriculum implementation. The explanatory power (R^2) values further underscored these relationships, with learning activities demonstrating the highest variance explained (71.7%), followed by objectives, grouping, and teacher's role, all above the 60% threshold. Predictive relevance (Q^2) values supported these findings, confirming that the model

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possesses strong predictive capability, especially for dimensions that directly influence learner engagement and instructional effectiveness.

The strong performance of learning activities within the model aligns with the literature emphasizing the role of active and experiential learning in vocational education (Cahapay, 2020; Dorandish et al., 2019). Practical tasks, simulations, and project-based learning allow students to apply theoretical knowledge in realistic contexts, thereby enhancing skill retention and transferability (Fathi Vajargah, 2022; Olumuyiwa et al., 2023). In technical and vocational settings, the integration of such activities is often cited as a decisive factor in program success, as they bridge the gap between classroom instruction and workplace requirements (Jafari et al., 2023; Sadri et al., 2017). The high β value for objectives indicates that clearly articulated, competency-based goals are equally critical in guiding both instructional planning and student learning outcomes (Klein, 2017; Salehi Omran & Ein Khah, 2023). Research has shown that when curriculum objectives are explicitly linked to industry standards and job-specific competencies, learners are more likely to achieve targeted performance levels and adapt to changing work environments (Alashwal, 2020; Zervas & Stiakakis, 2024).

The substantial influence of grouping on the overall curriculum model is consistent with studies highlighting the benefits of collaborative learning in skill acquisition. Group-based tasks promote peer-to-peer interaction, foster communication skills, and enable learners to tackle complex problems collectively (Baştemur & Uçar, 2022; Şenol & Karaca, 2025). In vocational education, where teamwork is often a prerequisite for professional success, structured group activities can enhance not only technical proficiency but also soft skills essential for employability (Musendekwa, 2025; Ndibalema, 2025). Similarly, the significant role of teacher's role within the model underscores the need for educators who are both technically competent and pedagogically skilled. Previous research has established that teacher effectiveness is a decisive factor in vocational training outcomes, with instructors serving as mediators between curriculum design and learner engagement (Baştemur & Uçar, 2022; Musendekwa, 2025). The integration of digital competencies into teacher training is also crucial, given the increasing emphasis on technology-enhanced learning (Zervas & Stiakakis, 2024; Zhang & Wu, 2025).

Other dimensions, such as facilities, evaluation, and location, demonstrated moderate to high β values, suggesting that while they may not be as central as learning activities or objectives, they still contribute significantly to curriculum quality. Adequate facilities and learning environments have been repeatedly identified as enablers of effective vocational education (Harfati Sobhani, 2017; Sadri et al., 2017). Similarly, robust evaluation systems are essential for monitoring learner progress, ensuring alignment with learning objectives, and providing feedback for curriculum improvement (Cahapay, 2020; Dizon, 2022). The relevance of location as a factor may be attributed to accessibility, community engagement, and proximity to industry partners, all of which can influence learner participation and the integration of workplace learning opportunities (Jafari et al., 2023; Olumuyiwa et al., 2023).

The relatively lower β value for logic within the model suggests that while the logical structure of the curriculum is important, it may exert less direct influence on learner outcomes compared to more operational elements like activities and objectives. Nonetheless, logical sequencing and coherence in curriculum design remain necessary for ensuring that content builds progressively toward competency mastery (Fathi Vajargah, 2022; Klein, 2017). The finding that content had a moderate β value aligns with literature suggesting that in vocational training, content relevance is essential but must be complemented by strong pedagogical delivery and active learning methods (Alashwal, 2020; Dorandish et al., 2019). This underscores the shift from content-heavy curricula toward competency-based approaches that prioritize application over memorization (Salehi Omran & Ein Khah, 2023; Zervas & Stiakakis, 2024).

The high Goodness of Fit (GOF) value of 0.569 further reinforces the conclusion that the proposed model is both statistically robust and theoretically sound, exceeding the benchmark for strong fit as suggested by Wetzels et al. (2009). This confirms that the model adequately captures the complexity of skill-based curriculum design in technical and vocational education and provides a reliable framework for future program development. The combination of high reliability, strong convergent and discriminant validity, and significant path relationships suggests that the model can be confidently applied in practical settings to guide curriculum planning, implementation, and evaluation.

These findings resonate strongly with international research on curriculum development in vocational education, which emphasizes the integration of competency-based objectives, active learning, teacher effectiveness, and the strategic use of resources (Olumuyiwa et al., 2023;

Zervas & Stiakakis, 2024; Zhang & Wu, 2025). They also align with calls for vocational programs to incorporate digital skills, collaborative learning structures, and continuous evaluation mechanisms (Musendekwa, 2025; Ndibalema, 2025). By validating a comprehensive skills training curriculum model through rigorous quantitative analysis, this study contributes to both the theoretical discourse and the practical toolkit available to curriculum developers, policymakers, and practitioners in the TVET sector.

Despite its contributions, this study is subject to several limitations. First, the sample was limited to experts and specialists within the fields of curriculum studies and technical/vocational education, which may limit the generalizability of the findings to broader stakeholder groups, such as students, employers, or policymakers. Second, the study's reliance on self-reported questionnaire data introduces the potential for response bias, particularly in the assessment of subjective constructs like teacher's role or curriculum logic. Third, while the use of structural equation modeling provided robust statistical validation, the study's cross-sectional design restricts the ability to infer causal relationships between constructs. Finally, the model was tested within the specific context of the Technical and Vocational Training Organization, and its applicability to other educational or cultural contexts remains to be examined through comparative studies.

Future research could address these limitations by expanding the sample to include a more diverse range of stakeholders, such as students, employers, and industry representatives, to capture multiple perspectives on curriculum quality. Longitudinal studies would be valuable for assessing how the relationships between curriculum components and outcomes evolve over time, particularly in response to technological or policy changes. Comparative studies across different vocational training systems or cultural contexts could provide insights into the adaptability and universality of the validated model. Additionally, mixed-method research designs incorporating qualitative interviews or focus groups could enrich the understanding of how curriculum components interact in practice, offering a more nuanced view of their relative importance and implementation challenges.

Practically, the validated skills training curriculum model can serve as a guiding framework for curriculum planners and policymakers within the Technical and Vocational Training Organization and similar institutions. Emphasis should be placed on strengthening active learning components, clearly defining competency-based objectives, and fostering collaborative learning environments. Teacher training programs should integrate both pedagogical and digital skills to ensure that instructors can effectively deliver modern, technology-enhanced curricula. Resource allocation should prioritize facilities, digital infrastructure, and evaluation systems that directly support learner engagement and skill acquisition. Finally, ongoing curriculum review processes should be institutionalized to ensure that content remains relevant, coherent, and aligned with evolving labor market demands.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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